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Space Technology 5

Power System Electronics Accommodation for a Lithium Ion Battery on the Space Technology 5 (ST5) Mission

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Space Technology 5 Constellation

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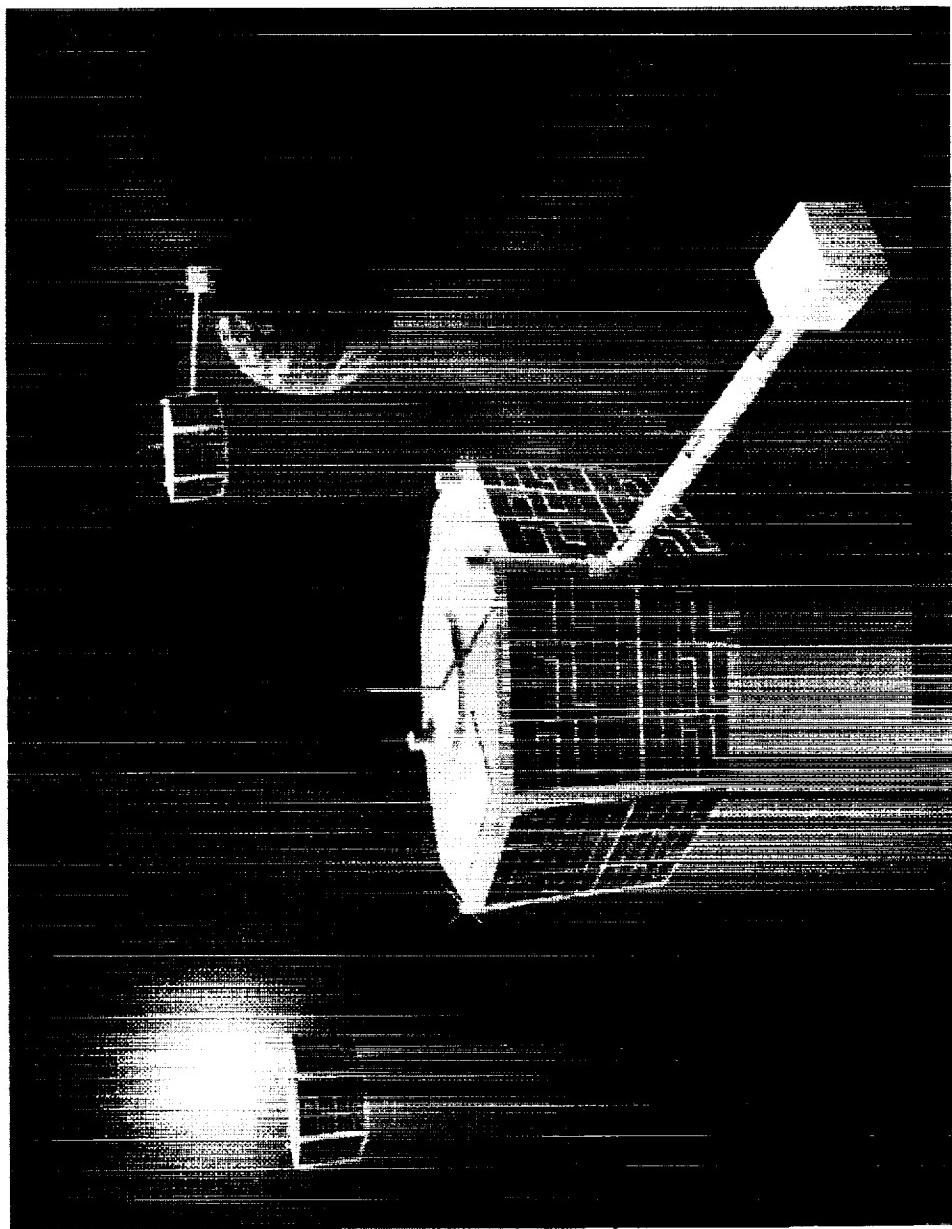
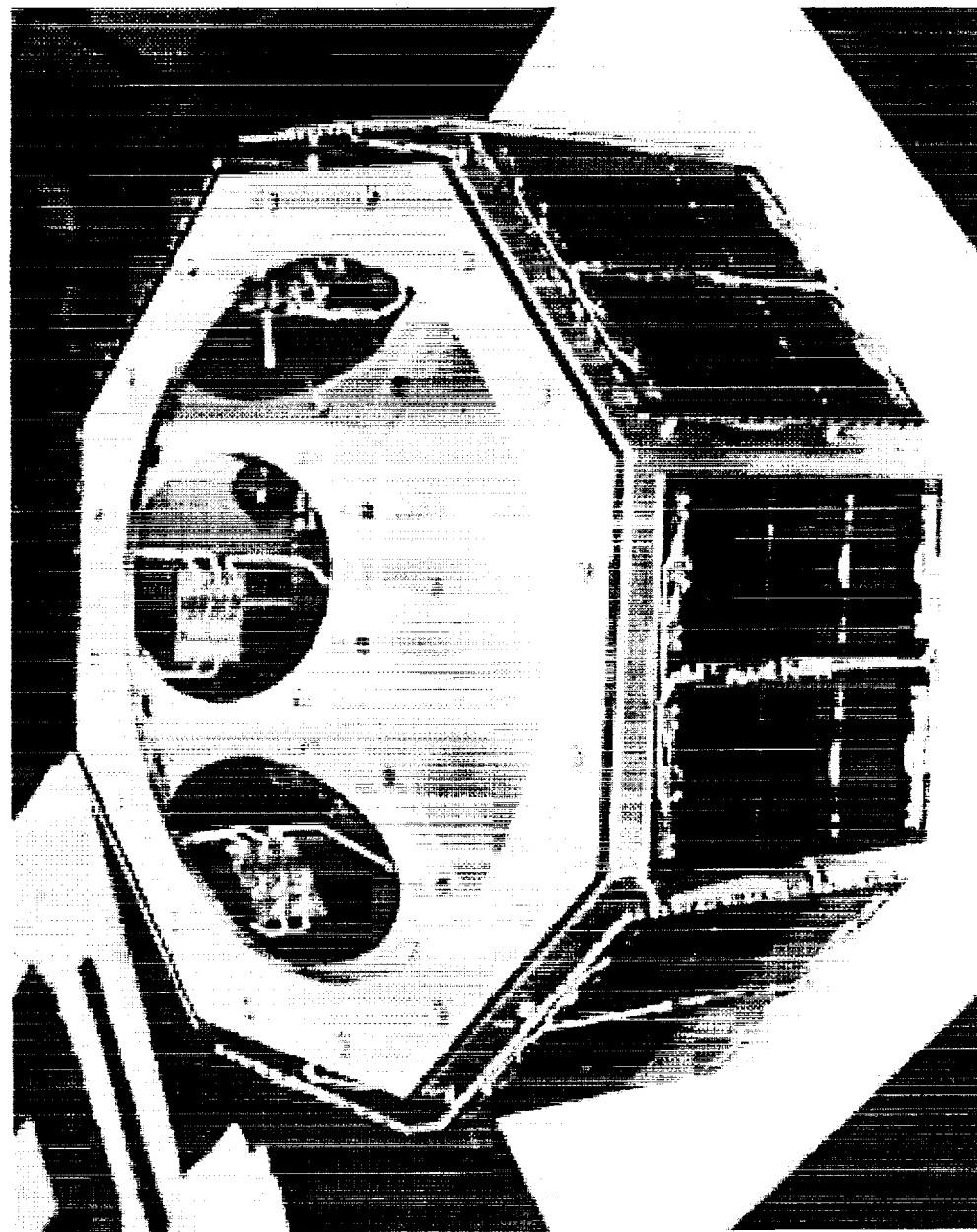


Photo of ST5 Nanosat Model

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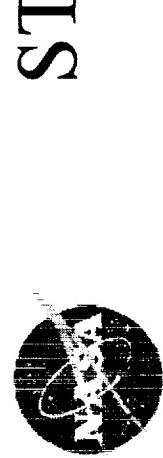
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Original Concept for Li-ion Accommodation on ST5



- ◆ Use Large Amp-hour cells (Approx. 5Ah)
- ◆ Electronics required to provide functions at the cell level:
 - Individual Cell Charge Control
 - Individual Cell Protection
 - Individual Cell Monitoring
- ◆ Original design included:
 - Individual Cell Charge Control
 - Independent cell chargers – Voltage taper
 - Individual Cell Protection
 - Overcharge protection-- Voltage clamp, Cell bypass
 - Individual Cell Monitoring
 - Voltage, Temperature monitoring for each cell
- ◆ Resulting electronics grew in mass, complication in order to satisfy cell level requirements
- ◆ Concerns over reliability:
 - additional electronics
 - failure of large amp-hour cell

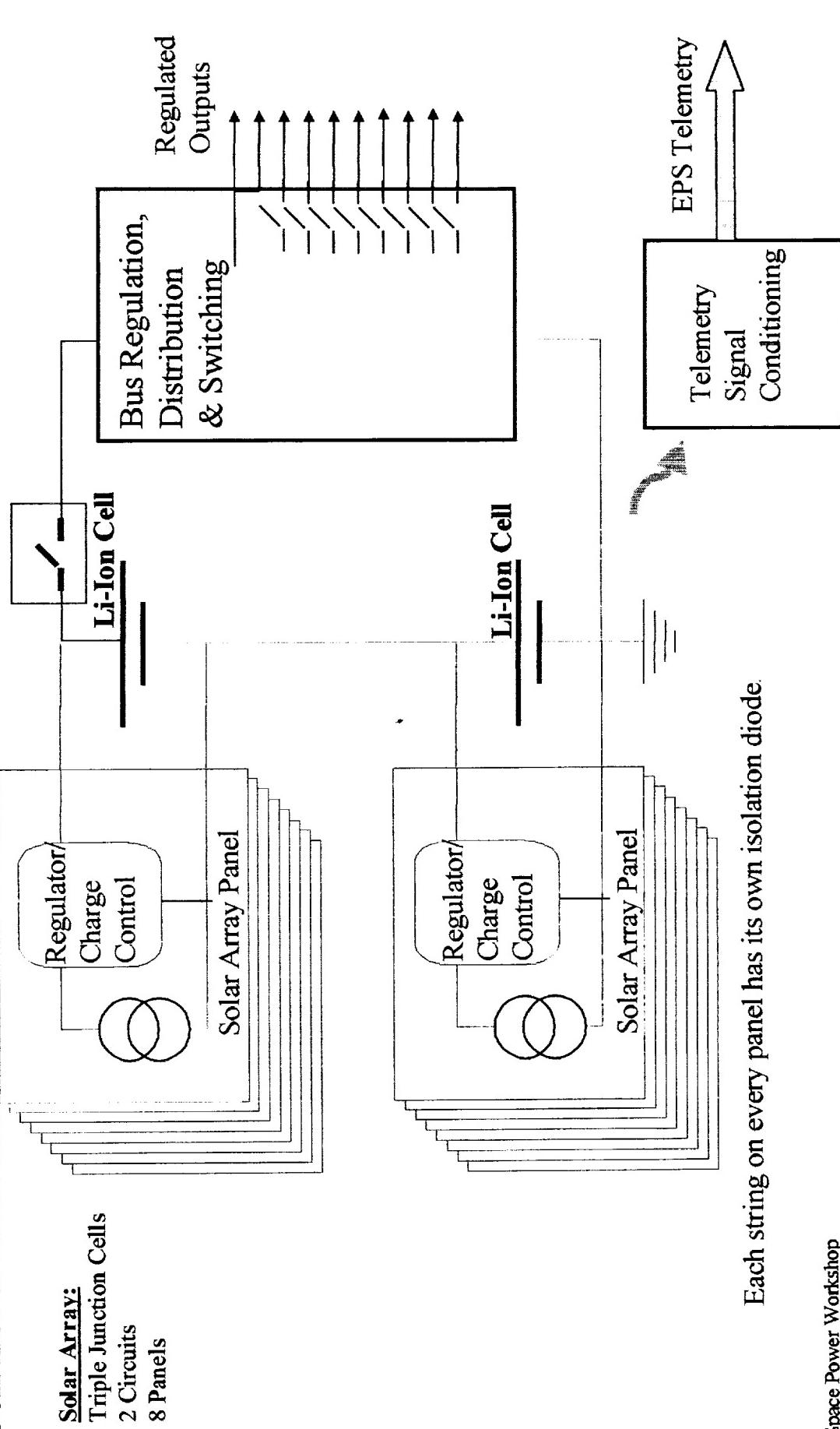


ST5 Electrical Power System--

Original Concept

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•Cell Level Electronics

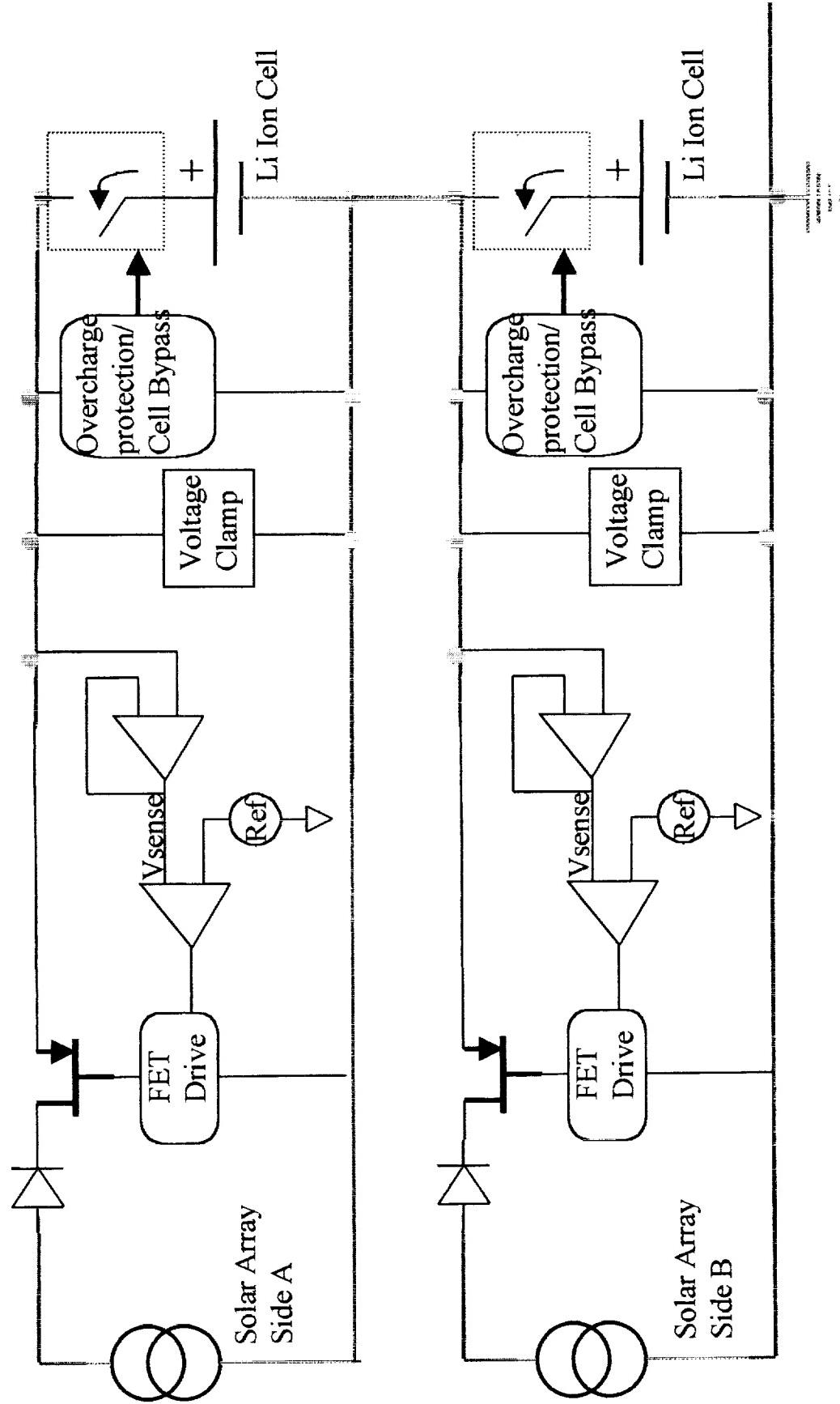


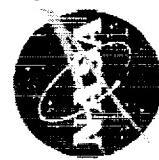
Each string on every panel has its own isolation diode.

Simplified Electronics Diagram--

Cell Level Electronics

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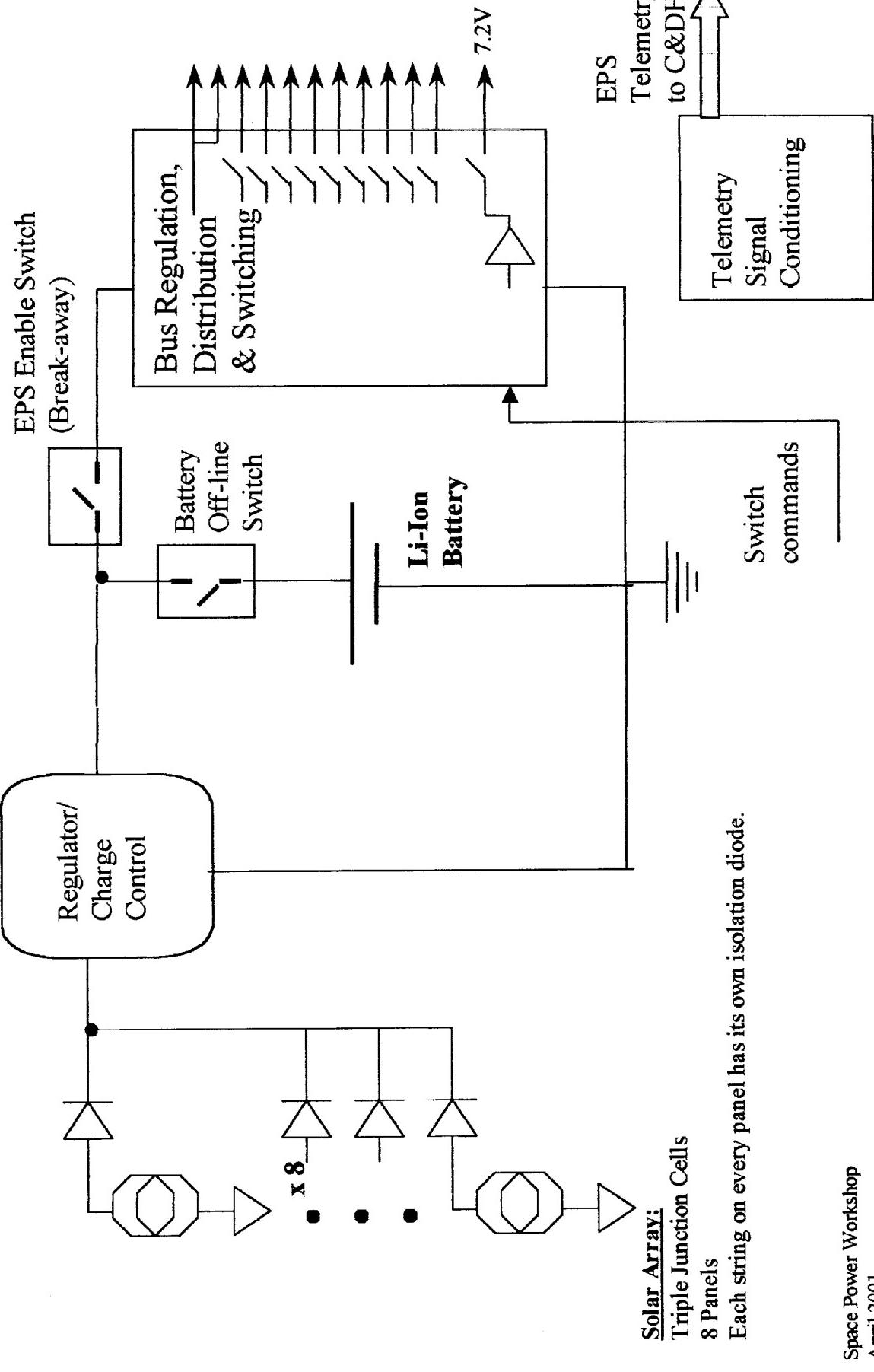
Revised Design with Optimized System Mass

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- ◆ Uses smaller amp-hour size cells (18650, 1.5Ah)
- ◆ Screened and well-matched cells
- ◆ Electronics required to maintain battery are at battery level:
 - Battery level charging-- (Voltage taper)
 - Battery level overcharge protection-- voltage clamp, no bypass
 - Battery level monitoring for control
 - Cell level monitoring for information only
- ◆ Lowers system mass
- ◆ The result is an increase in reliability
 - Reduction in circuit complexity
 - Cell failure would have smaller impact on system

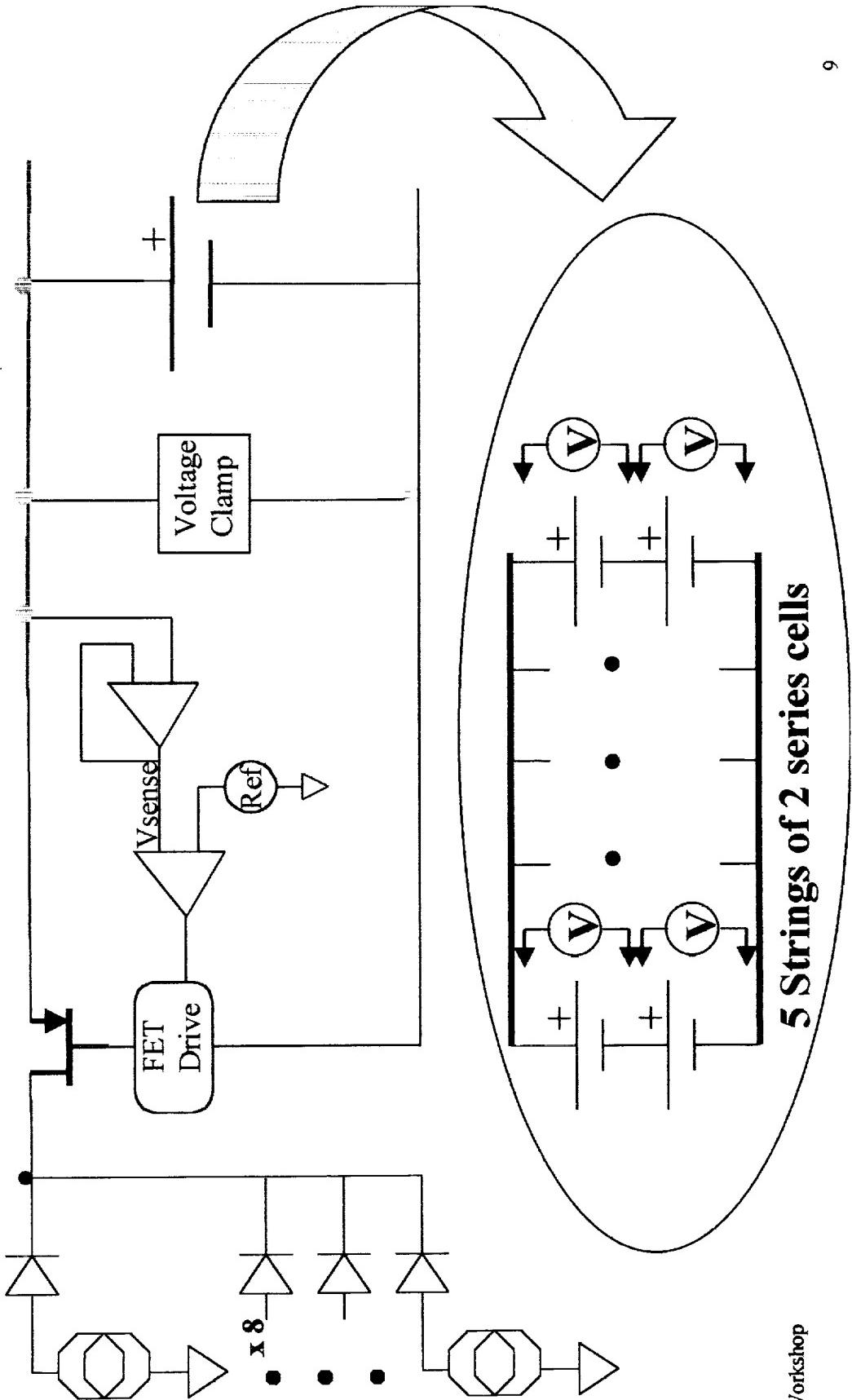
Present Design Concept--

Battery Level Control



Simplified Electronics Diagram-- Optimized System Mass

- Charging at the Battery level
- Monitoring at the Cell level (for information)



Conclusions/Comments

- ◆ ST5 mission requirements include validation of Lithium-ion battery in orbit.
- ◆ Accommodation in the power system for Li-ion battery can be reduced with smaller amp-hour size, highly matched cells when compared to the larger amp-hour size approach.
- ◆ Result can be lower system mass and increased reliability.